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THE CROP.

Grinding has ceased upon all but a very few of the plantations, and the season, as a whole, has been a satisfactory one so far as the amount of sugar marketed is concerned. The advance in the price of sugar which occurred about the middle of August benefited to a considerable degree only those plantations who were late in getting off their crop and those who shipped around the Horn by sailing vessel. The plantations that shipped to San Francisco or by steamer around the Horn were too early in marketing their sugars to obtain the benefit of the improvement, and there is consequently some disappointment felt, especially when fair prices and consequent dividends are so much needed.

The 1903 crop will probably be found to be close upon 420,000 tons. The 1903-4 crop is, for the most part, promising Some of the plantations will probably feel the effect of leaf hopper ravages, but this pest seems to be under control—for the present at least. It will not be long before the harvesting and grinding of this crop will be in full swing.

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THE FUTURE OF THE SUGAR MARKET.

The final action of the British government just before the adjournment of Parliament, in prohibiting the importation into Great Britain of any sugars whereon export bounties direct or indirect had been paid, will even up the European sugar market and enable us to judge somewhat of the probable effect of the abolition of the sugar bounties.

The European markets are now embarrassed with the presence of about a million tons of old crop sugars which may enter Great Britain, as the new law and the ordinances of the Brussels convention only apply to sugars made after September 1, 1903. All of these old sugars will probably go to England and are sufficient to supply England for about two-thirds of a year. This will cut off the aemand for new crop beet sugars and must necessarily have a very depressing effect upon prices.

From New York we learn that the situation in Europe is without apparent influence in the United States; i. e., that the sugar refiners are indifferent to the situation in Europe, as they have plenty of cane sugar accessible, and at about three-tenths of a cent per pound below the parity of European beet sugars. This is all a bluff. The sugar refiners all carry light stocks of sugar, and as was shown in his letter in our last issue by our Havana correspondent, the refiners will need about a million tons of sugar to cover their wants during the last five months of this calendar year. There are about 300,000 tons of old crop sugar in Cuba. At the outside no more than 250,000 of this can be counted on to come to the United States. Perhaps 200,000 tons of the Louisiana crop can be availed by the same time. Where will the other 550,000 tons come from? Some odd lots will come in from the British West Indies, but their crop is about all sold out and there seems no alternative for the American sugar refiners but to shut down before the end of the year for want of their raw material just as the cotton factories are now doing; or they must enter the European market and buy new beet sugars. September will bring a new supply of new beet sugars and our refiners can have a monopoly of them as the old sugars would be excluded by our countervailing duty, and yet they would have free access to England.

The Eastern sugar refiners are therefore profoundly concerned about prices in Europe. They have held the Cuban crop down to the level of values that permitted some English buyers to come into the Cuban market for the first time in twenty-five years. If they try to force the Cuban market lower, they wont get the sugars, England will take them. Just as Vanderbilt said to put on certain goods as heavy a freight rate as they would stand, just so the three-tenths deduction is put on Cuba sugar because it is on this side the Atlantic, but Cuban sugar wont stand any more deduction. England will take enough of the Cuban crop to even the market.

Should the sugar refiners succeed in getting a reciprocity treaty with Cuba abating the duties on sugar say 20 per cent. the Cuba planters would reap no benefit from it. It would simply lessen the price of Cuban sugar 3-8 cent per pound. Cuban sugars are now held down 3-10 cent per pound because they are made on this side of the Atlantic and it requires the depression of the Cuban market to the extent of this 3-10 cent per pound to permit Cuba to be a competitor with beet sugar in England.

Now our proposed reciprocity treaty will be of no advantage to an English buyer. It is presumed that American buyers alone will get the advantage of the 3-8 cent per pound that the proposed reciprocity treaty would concede. The Cuban sugar market will be held 3-10 cent below the European market, because it has been done and lies within the power of those who buy the Cuban crop. Why should they let it go any higher if they can hold it down to 3-10 below Europe? The European beet sugar crop sets the price of sugar for the world, and in competing with it cane sugar is held down by conditions as to color, remoteness, freights, current finances, etc.

If reciprocity comes, which we should sincerely deplore, as it would do us great harm and the Cubans no good, sugar in Cuba will continue to sell at 3-10 cent per pound below the parity of Europe, and sugars in the United States will sell at 3-8 below the parity of Cuba. The Cuban crop now so nearly supplies all our wants that it places in sight sugar enough for 1904 to permit the refiners to force the market as hereinabove indictated.—[Louisiana Planter.]

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THE LABOR PROBLEM WITH LOUISIANA PLANTERS.

The labor problem on the sugar plantations of Louisiana has always been one of difficult solution. Referring to it, Mr. J. M. McBride, the well-known sugar planter of Terrebonne parish, in a recent interview, spoke of the difficulty in getting an adequate labor supply and of the fact that the negro seemed disposed to go to New Orleans, while the Italians rarely ever served more than a year or two on the sugar plantations, and were then diverted to some other labor channel.

This labor problem has been presenting itself to the sugar planters of Louisiana ever since the civil war, and it seems wonderful how well we have succeeded thus far in its solution. The adaptation of machines to every possible portion of our agriculture is what has made it possible to continue in the industry thus far. The old hand hoe problem has been relieved by the use of the modern rotary or machine hoe. There is now not one-tenth of the hand work done that was done a quarter of a century ago. Stubble digging, so far as the labor involved in it is concerned, has been very much reduced by our modern stubble shavingmachines and stubble diggers. For the invention of that one successful machine alone, our well-known field expert, Mr. James Mallon, deserves to have a monument erected to his memory when he shall have passed away from the scene. His invention of other machines and the adaptation of still others to our sugar cane work have rendered him a necessary factor in the record of our progress in Louisiana. And we shall hope that he will continue to aid us for many years yet.

The Comeaux cane cart for cane planting is another invention that has done a great deal to diminish the call for human labor in that very important feature of our industry. Moore's cane hook, for taking cane out of windrow, is another splendid labor-saving device, and is doing its share to solve the labor problem.

While our negroes are extremely well adapted to our Louisiana cane field work, all of the younger ones are turning to the city on account of the large wages there offered, although they make far less time in the city than they can in the country, but the higher per diem paid is a great attraction to them, and they will remain in town until almost starving rather than come to the country, where they may get a less per diem, though their labor will last throughout the whole year.

The Italian labor supply, which thirty years ago was practically unknown on the sugar plantations of Louisiana, and, in fact, unknown anywhere in the United States, continues to be a fair source of our labor supply here, but the Italians are now in such demand where steady, sober and industrious labor is needed, that we have now far fewer of them on the sugar plantations than we had ten or twenty years ago.

Our mechanical devices for cane cutting, cane loading, cane planting, and for mechanical cane feeding at the cane carriers, although expensive, are what have saved the day for us here in Louisiana, and have enabled us to maintain our leading position in the cane sugar world, so far as the economic processes of cane handling and manufacture are concerned. The labor troubles in Hawaii and Cuba promise to continue, and will certainly develop here in Louisiana, unless we learn how to do still more of our work with mule or steam power. Our great progress in that direction justifies us in further hopes for the future.—Louisiana Planter.

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BEET AND CANE SUGARS AS INDUSTRIAL FACTORS.

In a review of a book on "Sugar Production and Sugar Premiums," by Max Schippel, Das Handels Museum of July 16, 1903, official organ of the Austrian Government, publishes matter of almost universal interest. It says, among other things, that certain neglected fields have been investigated and facts furnished that can not fail to be of interest to all who participate in any way in the production and distribution of beet or cane sugar. Attention is first called to the enormous interest India has in the maintenance of the old, primitive methods of boiling the sugar. The writer then deals with the disastrous catastrophe that has overtaken and almost overwhelmed the sugar plantations of the West Indies. Attention is called to the West Indians' powerlessness to compete with the beet-sugar producers of Europe; also to the difficulties that beset the path of North American sugar producers because of inadequately trained labor. In regard to the results that are expected to follow the aims and efforts of the recent congress of sugar-producing countries held at Brussels for the purpose of finding a way to avoid disastrous competition and premium paying, the paper quotes Schippel as follows:

"In the competition between the former premium-paying countries, the dismantling of the factories of individual participants does not make such a very great difference."

In other words, no very noticeable change has been effected. As far as relatively favorable positions are concerned, Germany, under the arrangement proposed, would come out ahead. The sugar production of its neighbors, particularly France, would lose more than Germany. The separate or special favors granted by the congress to Italy, Sweden, and Spain, says Mr. Schippel, conceal no new danger, but rather some profitable features compared with the present situation. These countries, by staying away from the conference, could have enacted or kept such sugar laws as would ultimately have raised them to the position where they would be able to provide for themselves; Italy is almost at that point. Sweden, with her premiums and protective tariffs, was able, as far back as 1901-2, to get along without sugar imports. Spain, whose sugar supply consists of two-thirds beet sugar ane one-third cane sugar, is producing more now than the nation needs. Special care has been given to the beet-root-sugar industry since the colonies were lost. Plans are on foot for reducing the production by effecting a union of some kind of all those interested in the production of sugar. The participation of these states in the conference has led to one good thing, viz, that when they become sugar exporting states, if they ever do, they will be bound by the treaty or agreement arrived at in the conference (article 6). On the other hand, they are already bound to find compensating measures against the sugar that comes in from premium-paying countries. Thus, so far as they import sugar at present, they must seek their supply, or the largest part of it at least, in the land bound by the contract. The careful watching of sugar in transit will be of value.

Mr. Schippel says, further, that one needs to have no fear of Russia. She opposes export premiums, in consequence of her system of lawmaking, and claims in all cases, on the basis of the most-favored-nation clause, exemption of her sugar from customs penalties. Still, her position in this respect has been exceedingly unlucky. In 1887-88, at the London conference, Russia joined those, without any reserve, who claimed that compensating duties did not violate the most-favored-nation clauses. Since 1897 the United States treats Russian sugar as a product to which a premium is paid. In 1899 India began to do this. Nowhere has Russia's claims been allowed. Now, if all the other interested parties—England, Germany, Austria-Hungary, her ally France, Belgium, Holland, Spain, Italy, and Sweden—oppose her, is Russia going to remain in opposition? It is easier to think of her joining the convention, or that she would turn to the development of Asiatic markets—India excepted—and to supplying her own home market with its wonderful possibilities of development and expansion.

The reform propositions put forth by Russia about the middle of February, 1903, would indicate a tendency toward the solution just indicated. Mr. Schippel, after careful consideration of the question whether cane sugar is ever again to occupy its old place in the industrial world in comparison with beet-root-sugar, replies in the negative. He sees no reason for thinking there is to be any very great change. He points out the possibilities in the sugar industry and claims that the German market is reserved for the factories of the Fatherland. He says its powers of expansion are enormous—so much so that in case of necessity it can be made to take the largest part of what the Empire exports. The present consumption in England, he says, is nearly 98 pounds per capita per annum; in Germany, only 30 pounds. By the time the Germans consume 98 pounds per capita per annum there will be little of the Empire's present sugar production left for exportation.

There were very considerable markets in which the two sugars—cane and beet-root—met, but always to the ultimate disappearance of the former. Witness Louisiana's cane sugar in competition with the beet-root product of the northern section of the United States. No one dreams of ever seeing the cane sugar drive its rival from the field.

Since the introduction of compensating duties the European premium-paid sugar finds itself upon the same plane as the imports of the normally taxed and not specially favored cane-sugar imports. This is true of the East Indies and the results are the same. France tried by means of complicated regulations to help its colonies in producing cane sugar, but to no purpose. The production fell off and the beet-root-sugar industries prospered. The same, with slight modifications, is true of Spain and Holland. Although German sugar got the smallest premium it was able to drive cane sugar from the English markets. Experience goes to show that the fears, long entertained, in regard to beet-root-sugar are groundless. Against them are the history of all tropical development. Tropical colonies will never have the intellectual power to expand and to move forward such as characterizes the electrical, almost tireless, movements of Europe. The men to unite the sciences with practical life, the perennial stream of expert farmers, chemists, and technicians, recruited from the middle classes, are impossible in the Tropics, where no such middle class exists. Capital will always have to count on enormous risks in the tropical colonies. These are the devastating forces of nature—various kinds of fevers, the uncertainties that attach to the workings of social institutions, the hostility of races, the failure of all law and order at times. The money needed from the sowing of seed to the harvesting, or from the beginning of an undertaking till the sale of the product, is not to be had and the financial organization for its control is far inferior to that of Europe. The greatest obstacle is found in the inability to properly organize labor. Whether one begins by building up small farms or by running huge plantations—worked by negroes and coolies, who are paid by the day, week, or month—the result will remain always the same. The production will be small and uncertain, as are all labor arrangements based upon the one-sided idea of one man's will. It is true that the tropical colonies have built up a better type of labor since the abolition of slavery. Both capital and labor haye been benefited thereby; but in many cases, hopes based upon these better conditions have been dashed to pieces. It often happens now that such hopes are destroyed. Where, however, they have not failed, but the good work has gone on and the people have persevered, the reward has not been wanting.—Consular Report.

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THE PURITY OF LOW-GRADE MOLASSES.

By Ernest E. Hartmann.

It is customary here, as well as in many cane-sugar factories abroad, to determine the sucrose in molasses by single polarisation after clarification with a greater or lesser quantity of subacetate of lead. Although it is quite generally realized that this method does not give the actual amount of sucrose, it is still employed on account of its simplicity, and owing to the belief that the analysis, if carried out under similar conditions, will give results, which, if not absolutely correct, are of use for comparisons. This belief is misleading; for instance, although the waste-molasses of Factory A have a purity of 35, and those of Factory B of 40, as found by single polarisation carried out under identical conditions in both cases, it is yet possible that the molasses of Factory B contain the same amount of sucrose, or even less, than that of Factory A, if the difference in the glucose contents is a very marked one. Add to this that the conditions under which the analyses are made in the different laboratories are by no means identical, and it will be conceded that the value of such data as criterion for the efficiency of the boiling department is rather problematical.

The factors, which render the method inaccurate, are the laevo-rotation of the reducing sugars and the volume and composition of the lead-precipitate. The former is compensated by inversion, according to Clerget's classical method; for the latter there is a simple way of making a correction, although this is not generally done. That without such a correction the subsequent calculations are based on too concentrated a solution is evident. Wiechmann made some interesting studies on these precipitates and their influence on polariscope-readings. (They were embodied in a paper read last June before the Congress of Applied Chemistry.) He restricted his investigations to sugars and molasses, the lowest of which contained 75 per cent. of sucrose.

Here we have to deal with molasses containing but 30 per cent. of sucrose, and consequently a much larger proportion of non-sugars.

Another error, as great as the one due to displacement, is caused by the precipitation of Levulose as Levulosate of Lead. The proportion between the Dextrose and Levulose in the solution being disturbed by the elimination of part of the Levulose, the dextro-rotatory power of the molasses is increased. Again an old established fact; but the extent to which the readings of molasses, such as we are dealing with here, is influenced, is not generally realized. In order to illustrate this, one-third the normal quantity of waste-molasses in 100 c.c. flasks was clarified with varying amounts of basic Lead-acetate of 1.25 specific gravity prepared according to the formula given in "Tucker," and also with a 25 per cent. solution of neutral Lead-acetate. The polariscope-readings of the filtrate are recorded below (calculated to normal quantity).

k	Subacetate of Lead:	50 c.c.	36.00
i	"	40 c.c.	35.34
h	"	30 c.c.	33.96
g	"	20 c.c.	31.25
f	"	10 c.c.	28.29
e	"	5 c.c.	26.76
d	With correction	e—(f—e)=	25.23
c	Neutral Acetate of Lead:	5 c.c.	25.14
b	"	2.5 c.c.	24.90
a	With correction	b—(c—b)=	24.66
	Percentage of sucrose found by Clerget's method—		
l	(Clarification with 5 c.c. neutral acetate:		32.58
m	Percentage of sucrose found by Fehling's method:		31.50
n	Glucose %		23.16
o	Brix° Dilution 1 : 3		91.05
p	Corrected for error caused by dilution		88.7
q	Actual (representing % Total Solids)		81.2
r	Water		18.8

Purity Actual lx100 : q		40.1
" as given usually fx100 : o		31.1
Alkalinity*		1.2

. This shows how vastly different values can be obtained for the purity; a, b, c, d, e, f, or even g, or l or m, may be divided by o, p, q, or a figure higher than o, if more water is used for diluting the molasses. Anything between the two extremes l x 100 : q=40.1 and a x 100 : o=27.1 may be found, according to the preference of the operator, surely a very wide range. The true purity, i. e., the quotient of the sucrose and the total solids is in this case 40.1, a figure one-third higher than the quotient of polarization and Brix as commonly determined to represent the purity (in this case about 30).

In the case of molasses of higher purity the differences are less marked. Below is the average of the results of a number of analyses of No. 2 molasses.

Subacetate of Lead:	40 c.c.	43.20
"	30 c.c.	43.28
"	20 c.c.	42.16
"	10 c.c.	39.24
"	5 c.c.	37.20
With correction for precipitate:		35.16
Neutral Acetate of Lead:	5 c.c.	35.20
"	2.5 c.c.	35.04
With correction for precipitate:		34.88
Percentage of sucrose found by Clerget's method— (Clarification with 5 c.c. neutral acetate):		39.84
Percentage of sucrose found by Fehling's method:		38.56
Glucose %		17.60
Brix: Dilution 1 : 3		89.00
Actual (representing % of Total Solids)		81.0
Water		19.0
Purity Actual 39.84 x 100 : 81.0		49.2
" as given usually 37.20 x 100 : 89.0		41.8
Alkalinity		1.0

Any attempt to utilize these data to establish a constant factor for correction would be futile, as the composition of the molasses varies with different varieties of cane, localities, maturity, treatment in factory, etc. There is but one way of finding the exact amount of sucrose in the molasses. Unfortunately Clerget's method requires too much time to be suitable for ordinary factory routine work. In order to overcome this difficulty a weekly sample of molasses should be made up, in which at the end of the week the sucrose would be determined according to Clerget's method; also in the ordinary way with

* The Alkalinity is expressed in cubic centimeters normal-solution required to neutralize 100 grammar.

a constant quantity of Subacetate of Lead. The water and the glucose should also be determined in this sample, as well as the density according to Brix. For the daily control work the customary method with Subacetate would be adhered to, care being taken that the quantities of molasses weighed, as well as the quantities of the reagent, are the same. The results thus obtained would fulfill their object of furnishing a comparison between individual strikes. Should it be desired, the correction found by analyses of the weekly sample could at the end of the week be applied to the individual results.

The dilution method for the correction for precipitate compensates the displacement only, not taking any account of the composition of the precipitate. In consequence about half the error is left unchanged. A better formula is the one employed in the above tables, although it is not entirely satisfactory either, being based on the supposition that the precipitate caused by the first 2 1-2 (5) c.c. is similar in quality and quantity to that caused by the second 2 1-2 (5) c.c. That the two are not exactly the same is shown below.

A series of experiments were made with a view to ascertain the relative importance of the two causes of the precipitate error, i. e., the displacement of liquid by the precipitate and the elimination of Levulose; 6.5 grammes of molasses dissolved in a 100 c.c. flask were precipitated with 10 resp. 20 c.c. of Subacetate, the precipitate washed by decantation, dissolved in acetic acid and filtered. The readings were as follows:

	1	2	3	4	5	6	Average
Filtrate from basic precipitate:							
20 c.c. Subacetate..	8.5	8.4	8.0	7.6	8 05	8.46	8.17
10 c.c. "	7.6	7.5	7.2	6 8	7 12	7.55	7.27
Increase in polarisation caused by the second 10 c c. of Subacetate	.9	.9	.8	.8	.93	.91	.90
Acid solution of precipitate (reading corr. for Temperature):							
20 c c. Subacetate....	—1.20	—1.02	—.98	—.97	—1.05	—.97	—1.03
10 c.c. "	—.70	—.58	—.54	—.66	—.54	—.48	—.58
Laevo-rotation caused by the second 10 c.c. of Subacetate..................	—.50	—.44	—.44	—.31	—.51	— 49	——.45

This indicates that about half of the total error is due to the elimination of Levulose. It also shows that the first 10 c.c. of the Subacetate precipitate a larger amount of Levulose than the subsequent 10 c.c. Samples of No. 2 molasses behaved similarly and showed the decrease in the later fractions of precipitates even more distinctly.

	Polarisation	
	Basic solution.	Acid solution.
20 c.c. Subacetate	10.18	— .85
10 c.c. "	9.37	— .51
5 c.c. "	9.00	— .28

The redissolved precipitate of the first 5 c.c. caused a Laevo-rotation of .28; the second 5 c.c. .23, and the subsequent 10 c.c. only .34. Thus, by applying the method used above for the correction for precipitate, the deduction made is probably insufficient. This is borne out by the difference between the corrected readings a. and d. It is for this reason preferable to use neutral acetate with Clerget's test. The error due to volume is then so small that even if it were neglected, no great error would ensue.

For the calculation of the purity it is necessary to know the percentage of water. It would, after all, matter but little, for comparative purposes, whether the degree Brix, as indicated by the spindle, and the percentage of total solids agreed or not, if the specific gravity of the components of the molasses were constant. This is, however, not the case. Of two samples of molasses both containing 18 % of water, the one may show 85, the other 90 or more degrees Brix. The direct determination of the water takes a little too much time to recommend itself for general adoption in control work; it may well be limited to the periodical average sample. It is practically impossible to dry low-grade molasses, such as our waste products, to a constant weight at a temperature, which admits of the operation being finished within a reasonable space of time. The most satisfactory results we obtained by drying the molasses in a current of dry air in the following manner:

Two grammes of filterpaper are crumpled, tied with thin wire into a roll and dried. This is weighed in a taxed test-tube 5 in. x 1 in. The paper is then removed and about 2 grammes of molasses are weighed in the tube and mixed with 2 c.c. hot water. The paper replaced in the tube evenly absorbs the whole of the liquid. The tube is then placed in a waterbath. A double perforated stopper, with which it is provided, allows a slow current of air, previously dried over calcium-chlorid or sulphuric acid, to be drawn through. If the water is kept boiling, the operation is finished in 2 1-2 hours. In order to ascertain the moment when all the water has escaped (the further diminution in weight is due to the volatilization of other components of the molasses only), parallel tests were made with 2 grammes of molasses and 2 grammes of sugar under exactly the same conditions. The weights found are as follows:

	Molasses.	Sugar.
Weight of tube + paper	18.068	20.821
" Molasses	2.034	2.140
Total before drying	20.102	22.961
After 1½ hours	19.751	22.912
" 2 "	19.734	22.906
" 2½ "	19.725	22.897

" 3 "		19.723	
" 3½ "		19.722	22.898
" 5 "		19.716	22.898
" 6 "		19.715	22.898
" 7 "		19.713	
" 8 "		19.710	
" 10 "		19.703	22.897
" 12 "		19.701	22.896
" 14 "		19.695	22.898
" 18 "		19.691	22.898
" 20 "		19.688	22.897
" 24 "		19.685	22.897
Percentage of water	=	20.102—19.725	22.961—22.897
		2.034	2.140
	=	18.5	.3

The weight of the tube with the sugar remained practically constant after 2 1-2 hours, and the molasses also had evidently lost all its water in the same time. The loss in weight sustained in 2 1-2 hours at the temperature of boiling water, the other conditions as described being adhered to, may therefore safely be taken to represent the water in the molasses.

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A RESTANT SOURCE OF ERROR IN OPTICAL SUGAR ANALYSIS.

By Dr. F. G. Wiechmann.*

The fact that the presence of the precipitate formed in clarifying sugar solutions is a source of error which may prove very considerable, has been known for many years.

Without attempting to go into the history of this matter, it may be of interest to state that even in 1867 J. Welz published an article on this subject in the *Zeitschrift des Vereins fur Rubenzucker Industrie*, Vol. 17, page 489. A glance through American, German, English and French publications since that time shows that this question has frequently occupied the attention of investigators of these nationalities.

In making their experiments investigators have generally followed one of two methods; that of Scheibler or that of Sachs. Scheibler's Method of Double Polarisation described in the *Zeitschrift des Vereins fur Rubenzucker Industrie*, 1875, Vol. 25, page 1054, is as follows: The normal weight of sugar is dissolved in distilled water; a measured amount of sub-acetate of lead solution is added, the volume is made up to a known

* A paper read at the International Congress of Applied Chemistry, at Berlin, June, 1903.

volume, say 100 cc., with water, the solution filtered, and polarised.

A second solution is prepared in the same manner, except that its volume is made double the volume of the former solution; in other words, the volume of this solution is made up to 200 cc., and this solution is then also filtered and polarised.

Assuming that the volume of the lead precipitate formed in both cases is identical, it is evident that the polarisation of the more dilute solution must be somewhat less than one-half the polarisation of the more concentrated solution.

To make this clear, suppose the volume of the precipitate formed = 3 cc. In the first case the solution would occupy a space of 100 — 3 = 97 cc. In the second case, the solution would occupy a space of 97 + 100 cc. = 197 cc.

If the polarisation of the first solution (100 cc. in volume) is equal to x polariscope degrees, the polarisation of the second solution (200 cc. in volume) would be equal to $\frac{97}{197} \times$ polariscope degrees.

The corrected polarisation would then be found in the following manner:—

Polarisation of Solution A (100 cc. in volume)................. = 96.80
Polarisation of Solution B (200 cc. in volume)................. = 48.25
48.25 × 2........ = 96.50
96.80
96.50
———
0.30 × 2.......... = 0.6
96.8 — 0.6........ = 96.2 Corrected Polarisation.

Of course the volume of the precipitate can also readily be calculated from these data.

$$A - (B \times 2) = D, \text{ and}$$

$$\frac{D \times 200}{A + D} = \text{Volume of Precipitation.}$$

Example: $A = 96.8$
$B = 48.25$

$$96.8 - (48.25 \times 2)$$
$$96.8 - 96.5 = 0.3$$
$$\frac{0.3 \times 200}{96.8 + 0.3} = \frac{60}{97.1} = 0.6.$$

Hence the volume of this precipitate is 0.6 cc.

This method of double polarisation is, however, open to several objections. When working with raw sugar, especially with low-grade cane products, it is almost impossible to secure absolutely identical samples for comparison in the two series of observations. But even if this difficulty could be overcome, for instance, by weighing out double the amount of sugar at the start, yet the doubling of the polariscope reading involves the material enlargement of any experimental error that may have been made.

To avoid the defects of this method, Francois Sachs, at the suggestion of Dr. K. Stammer, undertook to devise some other way of ascertaining the influence which the lead precipitate exerts on polarisation. He published an article bearing on this subject in the *Zeitschrift des Vereins fur Rubenzucker Industrie*, 1880, Vol. 30, page 229.

Sachs' method consists essentially of the following: A precipitate is produced by sub-acetate of lead. This precipitate is washed with cold and with hot water until all of the sucrose is removed, and is then introduced into a 100 cc. flask. A one-half normal weight of pure sugar is added, dissolved, and the solution is made up to 100 cc. with distilled water.

This solution is then well mixed, filtered and polarised, and the volume of the precipitate ascertained in the following manner:—

A = Percentage of purity of the sucrose in the solution.

B = Polarisation of this solution when containing the precipitate.

V = Volume of the precipitate is equal to $\dfrac{100\text{ B}-100\text{ A}}{\text{B}}$

Example: A = 99.90
B = 100.30

$$V = \frac{(100 \times 100.3) - (100 \times 99.9)}{100.3} = \frac{400}{1003} = 0.4 \text{ cc.}$$

In the course of this investigation, undertaken by the writer of these lines for the purpose of obtaining exact analytical data on certain cane sugars, a number of determinations were made by both the Scheibler and the Sachs method. In each instance only just enough sub-acetate of lead was used to ensure a proper decolorisation of the sugar solution—the slightest excess of reagent was carefully avoided.

The data secured were as follows:—

Experiment No.	Grade of Sugar.	Polarisation found.	Volume of precipitate.	Method used.
1	Demerara, centrifugal	96.8	0.6	Scheibler.
2	" "	96.7	0.5	Sachs.
3	San Domingo c'nt'f'g'l	96.1	0.5	Sachs.
4	Cuba centrifugal......	91.8	0.4	Sachs.
5	Cuba molasses........	90.0	0.6	Sachs.
6	Jlo-Jlo mats..........	89.5	1.1	Scheibler.
7	Jamaica muscovado..	86.8	0.3	Sachs.

8—Maceio	86.1	0.9	Sachs.
9—Molasses	83.1	1.0	Scheibler.
10—Cuba muscovado	82.7	0.7	Sachs.
11—Bahia	76.6	1.0	Scheibler.

The results obtained exhibited such marked differences for sugars of different origin, but of approximately the same polarisation, that it seemed desirable to secure additional data, and, incidentally, to seek some indications as to the physical characteristics of the precipitates found in different grades of sugar.

This part of the work was carried on in the following manner:—

A solution of sub-acetate of lead was prepared in exact accordance with the directions of the International Commission for Uniform Methods of Sugar Analysis.

A normal weight-solution of the raw sugar to be examined was then made, and the minimum amount of sub-acetate of lead solution needed for its proper clarification was carefully determined by experiment.

The lead precipitate thus obtained was filtered on a weighed Schleicher & Schull filter and washed with cold and with hot water until the alpha-naphthol reaction for sucrose could no longer be obtained. Then the precipitate was dried to constant weight at 100° C.

Preliminary experiments having shown that pure benzene exercised no solvent action upon the precipitate, the specific gravity of the same was determined by aid of this reagent and then referred to the water standard. The specific gravity of the benzene employed was 0.6845.

The colonial sugars selected for these experiments embraced centrifugals from San Domingo and the Sandwich Islands, muscovadoes from the West Indies, molasses sugars from Porto Rico, concretes from San Domingo, and mats from Manila and Cebu.

The analytical data of these sugars appear in the following table:—

Experiment No	Sugar	Polarisation.	Reducing sugars.	Water.	Ash.	Suspended impurities.	Non-ascertained.
12	Jamaica muscovado	90.1	1.61	5.02	0.68	0.20	2.39
13	Maceio muscovado	85.4	4.35	5.60	0.75	1.06	2.84
14	San Domingo centrifugal	96.5	0.67	1.20	1.36	0.06	1.21
15	Sandwich Islands	97.6	0.45	0.60	0.40	0.04	0.91
16	San Domingo concrete	85.2	2.91	4.92	1.68	0.30	4.99
17	Porto Rico molasses	88.4	3.17	3.66	1.36	0.28	3.13
18	Sandwich Islands	89.2	1.60	2.58	2.19	0.20	4.23
19	Cebu mats	82.4	6.75	2.60	2.17	0.76	5.32
20	Manila mats	86.8	4.14	1.96	0.92	1.80	4.38

The weight, the specific gravity and the volume of the precipitates obtained from these sugars are listed below.

PRECIPITATES.

Experiment No.	Sugar	Weight in grammes	Specific gravity H_2O=1.000.	Volume. in cc.
12	Jamaica muscovado	0.4559	1.88	0.24
13	Maceio muscovado	0.8112	1.65	0.49
14	San Domingo centrifugal	0.2525	2.91	0.09
15	Sandwich Island cen't'fl.	0.1378	2.84	0.05
16	San Domingo concrete	1.0139	3.80	0.27
17	Porto Rico mol'sses sugar	0.8959	4.35	0.21
18	Sandwich Islands	1.0195	4.38	0.23
19	Cebu mats	1.5400	2.17	0.71
20	Manila mats	1.3350	2.22	0.60

Inspection of these data shows well how greatly the composition of the impurities in the different kinds of cane sugars must vary, for the specific gravities of these precipitates differ widely, from 1.65 to 4.38. In this connection it is of interest to recall the specific gravity values obtained by Sachs of some lead salts of organic acids. Among these were the citrate, tartrate, oxalate and carbonate of lead, and their specific gravity values were found to range from 3.05 to 6.27.

Another matter of interest to be noted is the fact that the most voluminous precipitates are not always found in low-grade sugars.

Thus, precipitates almost identical in volume were obtained from sugars differing materially in quality.

No.	Polarisation.	Volume of Precipitate.
12	90.1	0.24
18	89.2	0.23
17	88.4	0.21
16	85.2	0.27

To determine the extent to which polarisations might be influenced by the forming of lead compounds having specific optical properties, a complete set of parallel determinations was carried out with sugars No. 12—20.

In these tests a few drops of acetic acid were added after the sub-acetate of lead solution had been used. In only three instances, however, were polarisation-values observed differing from those previously found, and in no instance did such difference exceed 0.1°. The former were therefore retained.

The corrected polarisations (corrected for the error caused by the presence of the lead precipitate) were calculated in the following manner:

Let A = Per cent. of sucrose in the solution.
B = Polarisation of this solution when containing the precipitate.
V = Volume of this precipitate.

$$V = \frac{100\,B - 100\,A}{B}.$$

$$BV = 100\,B - 100\,A.$$

$$100\,A = 100\,B - BV.$$

$$A = \frac{100\,B - BV}{100}.$$

Example: $B = 90.10°$ Ventzke.
$V = 0.24$ cc.

$$A = \frac{(90.10 \times 100) - (90.1 \times 0.24)}{100}.$$

$$A = \frac{9010 - 21.624}{100}.$$

$$A = \frac{8988.376}{100} = 89.88,$$

and this is the value sought.

POLARISATION.

Experiment No.	Sugar.	Observed.	Corrected.	Diff.
1	Demerara centrifugal.	96.80	96.22	0.58
2	" "	96.70	96.22	0.48
3	San Domingo centrifugal. .	96.10	95.62	0.48
4	Cuba centrifugal.	91.80	91.43	0.37
5	Cuba molasses.	90.00	89.46	0.54
6	Jlo-Jlo mats.	89.50	88.52	0.98
7	Jamaica muscovado.	86.80	86.54	0.26
8	Maceio.	86.10	85.33	0.77
9	Molasses.	83.10	82.27	0.83
10	Cuba muscovado.	82.70	82.12	0.58
11	Bahia.	76.60	75.83	0.77
12	Jamaica muscovado.	90.10	89.88	0.22
13	Maceio muscovado.	85.40	84.98	0.42
14	San Domingo centrifugal. .	96.50	96.41	0.09
15	Sandwich Islands cent'f'g'l.	97.60	97.55	0.05
16	San Domingo concrete.	85.20	84.97	0.23
17	Porto Rico molasses sugar.	88.40	88.21	0.19
18	Sandwich Islands.	89.20	88.99	0.21
19	Cebu mats.	82.40	81.81	0.59
20	Manila mats.	86.90	86.37	0.53

In these sugars, therefore, the observed error caused by the presence of the lead precipitate ranges from 0.05° to 0.98° Ventzke.

It is difficult to understand how so serious, so well-known, a defect of polariscopic analysis should have been allowed to remain until this day.

No doubt, the difficulty of determining a proper correction factor has been the chief cause of delay in seeking a remedy for this evil. Aside from this, however, there is a very general, even if a very vague, impression that there are certain other sources of error inherent in the methods of saccharimetric analysis which, as it were, tend to counteract this plus error in polarisation; a false sense of security has been engendered —a feeling that, after all, the results obtained will about balance in the long run.

Whatever the grounds on which such delusive reasoning may have been based in the past, today there is no longer any excuse for such an assumption. The analytical methods formulated by the International Commission in 1900 carefully eliminate the influence which would lower the test.

It is well known that readings of sugar solutions obtained in a saccharimeter when the saccharimeter is at a temperature above the temperature at which the instrument has been graduated, are slightly lower than are the readings of such solutions when obtained at the graduation temperature of the instrument.

This phenomenon is due to the influence which an elevation of temperature exercises in the quartz-wedges of the saccharimeter—these quartz-wedges are expanded by a rise in temperature.

This cause of disturbance can, and, of course, should, be wholly eliminated by adjusting the saccharimeter with a pure sugar solution, at the temperature at which the readings are to be made. Or, if numerous sugar solutions are to be tested at various temperatures, it may perhaps prove more convenient to make the necessary correction for this error by calculation.

This is effected by use of the so-called Jobin formula, which reads:

$$\text{Polarisation} + (0.00016\,T)\,N.$$

In this formula T stands for the difference in temperature at which the sugar solution is prepared and polarised, and the temperature at which the saccharimeter has been graduated; N stands for the saccharimeter degrees of the sugar solution examined.

In the commercial analysis of sugars, this correction is generally not made. It is not made because it is held to offset, in a measure, the plus error due to the presence of the lead precipitate in the solution.

That the one error will, in part, counterbalance the other, is obvious. It seemed, however, of interest to learn something of the actual numerical relations existing between the two.

To gain this information, it was necessary to obtain reliable temperature data as a basis.

The mean annual temperature for Bostin, New York, Philadelphia and San Francisco, four of the principal ports of entry for sugar in the United States of America, was:—

	In 1901. C.	In 1902. C.
Boston	9.45°	9.78°
New York	11.28°	11.45°
Philadelphia	12.11°	12.33°
San Francisco	12.89°	13.00°

For these data the writer is indebted to the courtesy of the U. S. Weather Bureau, at Washington, D. C.

All of these temperatures are considerably below 20° C., the standard temperature adopted by the International Commission for the graduation of saccharimeters. The actual temperature conditions under which polariscopic determinations of sugars are made of course differ materially from these temperatures.

In order to obtain accurate data on this point the writer caused three observations a day to be made in his laboratory, at 8 a. m., at 12 m. and at 3 p. m. These observations were carried on for two years during 1901 and 1902. The averages of these observations, monthly and annual, are noted in the following table:—

	1901.	1902.	1903.
January	—	22.4	22.4
February	21.0	21.6	—
March	22.5	22.6	—
April	22.4	23.1	—
May	22.3	23.5	—
June	26.0	26.0	—
July	27.7	27.7	—
August	27.9	27.2	—
September	26.0	25.6	—
October	23.3	23.7	—
November	22.7	23.1	—
December	23.5	22.1	—
Average	24.12	24.05	—

Although fluctuations are to be noted in some of the corresponding months in the two years, yet there is not 0.1° C. difference between the mean annual averages of the two years. In 1901 for eleven months this value was 24.12° C.; in 1902 it was 24.05° C. It will therefore be practically correct to say that all tests made in both of these years were made at a temperature—on an average—of 4.1° C., above the standard temperature of 20° C.

Referring to Jobins' formula, it will be seen that the correction to be applied for 4.1° Centigrade temperature is calculated by the expression:—

0.000656 X Degrees Ventzke.

Doing this the following correction factors result:—

Experiment No.	Degree Ventzke.	Experiment No.	Degree Ventzke.
1	0.063	11	0.050
2	0.063	12	0.059
3	0.063	13	0.056
4	0.060	14	0.063
5	0.059	15	0.064
6	0.059	16	0.056
7	0.057	17	0.058
8	0.056	18	0.058
9	0.054	19	0.054
10	0.054	20	0.057

As in these experiments the saccharimeter was purposely not adjusted for the higher temperature (average = 24.1° C.), the observed volume error, caused by the presence of the lead precipitate, has already been diminished by the quartz-wedge error; the former, the plus error, must therefore be increased by the amounts just calculated in order to learn its true extent.

This leads to the following data:

Experiment	Plus error.	Minus error	Excess of Plus error.
1	0.643	0.063	0.580
2	0.543	0.063	0.480
3	0.543	0.063	0.480
4	0.430	0.060	0.370
5	0.599	0.059	0.540
6	1.039	0.059	0.980
7	0.317	0.057	0.260
8	0.826	0.056	0.770
9	0.884	0.054	0.830
10	0.634	0.054	0.580
11	0.820	0.050	0.770
12	0.279	0.059	0.220

13	0.476	0.056	0.420
14	0.153	0.063	0.090
15	0.114	0.064	0.050
16	0.286	0.056	0.230
17	0.248	0.058	0.190
18	0.268	0.058	0.210
19	0.644	0.054	0.590
20	0.587	0.057	0.530

Inspections of these figures shows that—considering all results—the plus error exceeds the minus error by from 0.05° to 0.98° Ventzke, on an average by 0.46° Ventzke.

If the data secured by the Scheibler method (Nos. 1, 6, 9, 11) be eliminated as possibly not equally trustworthy with the rest, then the plus error is found to exceed the minus error by from 0.05° to 0.77° Ventzke, on an average by 0.38° Ventzke.

The practice universally followed in commercial sugar testing—at least up to the introduction of the methods of the International Commission in 1900—the ignoring of the quartz-wedge error because allowance is not made for the error induced by the presence of the lead precipitate, is thus seen to be perfectly justified by the actual state of affairs.

In fact, as matters stand at present, it is evident that the Commission's regulations guarding, as they most properly do, against a lowering of test by the influence of the temperature on the quartz-wedges of the polariscope, aggravate, unintentionally, it is true, but nevertheless effectively, the evil resulting from the presence of the lead precipitate formed in clarifying the solution.

It will be remembered that the average excess of the plus error over the minus error was found to be 0.38° Ventzke. In commercial practice this figure would rather be apt to be higher than lower, for whereas in these experiments scrupulous care was taken to avoid all excessive additions of clarifying reagents, such care and precaution would and could hardly be taken in ordinary routine work.

On the other hand, the grade of raw cane sugars received would vary considerably in different years. If high-grade sugars should predominate, the magnitude of the volume error would be decreased; if low-grade sugars were purchased in greater quantity than usual, the error would assume larger proportions.

Considering all things, it will probably be rather below than above the truth to assume 0.25° Ventzke as the average plus factor of error caused in cane sugars by the presence of the lead precipitate.

This error also affects beet products, but to a less degree; Scheibler in 1875 evaluated it at 0.15 per cent. to 0.20 per cent., with a leaning toward the lower figure. This emphasizes the conservativeness of the figure 0.25 per cent., at which the writer has placed it for cane sugars; as before said, in all probability the error is greater than this.

But, whatever the extent of the error, the harm it works seems of sufficient importance to call for immediate and careful consideration with a view to its abatement.

Broadly speaking, two courses present themselves which might be followed to achieve this purpose.

On the one hand, the extent of the error, under various conditions, might be determined, and a correction therefore introduced. On the other hand, search might be made for some reagent or reagents whereby decolorisation of sugar solutions could be secured without the formation of any precipitate, and, of course, without affecting the optical properties of the sucrose solution.

Either course, whichever might be chosen, would necessitate a very considerable amount of work; of this the writer is thoroughly aware from his own tentative efforts along both of these lines of investigation.

Still, "before there can be applied science, there must be science to apply." It would therefore seem most proper to place this matter officially before the International Commission for Uniform Methods of Sugar Analysis.

This the writer would hereby do, and, in so doing, he would express the hope that this International Commission will charge itself with the devising and the introduction of a method in which this grave defect may be entirely avoided—a method to which the Imprimatur of this Commission may unhesitatingly be given.

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SUGAR CANE IN JAVA IN 1902.

The following notes, on the sugar cane crop of Java, are taken from the Report on the Trade and Commerce of Java for the year 1902, by Mr. Consul Fraser (Foreign Office: Diplomatic and Consular Reports, May, 1903):

The year under review has been anything but a prosperous one. The prices realized for the great staple of the island, sugar, were the lowest ever recorded, and although the crop was a heavy one—the largest so far produced—this fact did not compensate for the unremunerative values.

The weather during the past season was generally much more favorable for sugar planting purposes and for the growth of the cane than in either of the two preceding years. On some estates, in the eastern districts of the island, where, owing to the nature of the ground, the water was unable to penetrate, the rains which fell during the planting season in 1901 had an unfavorable influence on the production, as planting had to be done on ground which had not been sufficiently exposed; while the dry monsoon in 1902 commenced so exceptionally early that on many estates, where the ground held insufficient moisture, the cane quickly dried up, to the detriment of the percentage of sugar. The area planted was slightly larger than in 1901, and the production, on the whole, may be taken as favorable. The total crop amounted to the record one of 848,263 tons, as compared with the previous highest of 766,238 tons, in 1901.

With reference to cane diseases, Mr. Vice-Consul McLean reports as follows:

"There was less injury experienced from root disease, owing to heavier manuring with sulphate of ammonia, and the discovery of new varieties of cane which are proof against this sickness.

"The growing of cane from seed and from crossing has considerably increased, as the varieties produced, besides combining a large cane production with a high sugar percentage, appear to better withstand the cane diseases.

"The 'sereh' has thus met with a check, but, without special measures in the cultivation of the plant, this disease will continue to show its prejudicial effects."

The following table gives the exports of sugar for the year ending December, 1902, compared with the years 1900 and 1901. It will be noticed that the United States and China are the chief importers of Java sugar; very little is exported to Europe:

Country.	Quantity. 1900. Tons.	1901. Tons.	1902. Tons.
Europe	6,585	....	1,631
United States	419,808	292,169	405,368
Australia	72,990	83,099	71,717
China	113,474	148,603	134,033
Japan	31,559	36,694	47,458
Other countries	34,690	48,481	51,190
Total	679,106	609,046	711,397

—Louisiana Planter.

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Australia claims a record piping of water, the distance being 350 miles. A large dam, the Mundaring weir, which is 90 feet high and impounds 5,000,000,000,000 gallons of water, has been constructed across the Helena river near Perth, and water is pumped from the reservoir formed through steel mains at the rate of 6,000,000 gallons per day. There are a number of auxiliary reservoirs and pumping stations along the line, which runs parallel with the railroad into the Kalgoorlie mining district, reputed to be the "richest square mile of earth on the globe." This district lies in the extremely arid interior of

Australia, where there is no water to be had, and the wealth of the mines makes such a stupendous venture a paying one. The water is not used for irrigation, but for general purposes in the mining town. The engineering feat involved is noted because of its possible bearing on the question of long distance transmission of water.

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HOW SUGAR-CANES ARE RAISED FROM SEED.

The following intersting account of the method adopted at Barbados for raising new sugar-anes from seed has been contributed by Mr. J. R. Bovell, F. L. S. F. C. S., superintendent of the sugar-cane experiments connected with the Imperial Department of Agriculture. Mr. Bovell occupies a unique position in this matter, as he was one of the first to take up the work and has been continuously engaged in it since 1889:

"In Barbados the panicles (arrows) are gathered as soon as the spikelets begin to be blown away by the wind, or as soon as a slight shake of the stem of the cane causes a few to fall. The panicles are then put into thin muslin bags and hung in a dry, airy place where a certain amount of sunshine is obtainable. At the end of a few days, when all the spikelets are readily detached, these are rubbed off and returned to the bags to dry for a couple of days longer. The seeds are then sown in well drained boxes of sifted garden soil, covered lightly with fine soil, watered, finally covered with sheets of glass and put under cover where they can receive only a limited amount of direct sunshine. Usually at the end of the fifth day a few of the plantlets will be up. At the end of the second week, nearly all of those likely to germinate will have grown. The seedlings are then somewhat hardened by gradual exposure to fuller sunshine. By the end of the second month they are fit for transplanting; hey are then pricked off into small pots and placed under racks on which sacking is put during the hotter time of the day to protect them from the full blaze of the sun. By degrees this time is shortened until they no longer need any shade. Three months from the time the seed is sown the plants are ready and ought to be taken to the fields. But in Barbados, owing to the dry weather at this time of the year, it is necessary to let them remain in the pots until the rainy season sets in. The seedlings are now allowed to go on growing until the following December, when the most vigorous and largest clumps are regrown from cuttings in comparison with one of the standard canes. In the December of the second year of their growth the canes undergo a second selection based on their vegetative characters, a portion of the plot being kept for chemical analysis in the following reaping season. From now onwards the selection is based on the weight of the stems and the saccharine richness of each cane."—Agricultural News.

BAGASSE FIBRE.

We are generally quite familiar with the fact that Louisiana cane contains about 10 per cent. of fibre or marc, and that Cuban cane, being harder and woodier, generally contains a greater amount, ordinarily rated at 10 to 12 per cent. of the total weight of the cane. Our chemists have made many efforts to ascertain just how much woody fibre Louisiana sugar cane does contain, and the results are quite discordant. Sometimes we find as low as 9 per cent., and, in abnormally short-jointed canes, as high as 20 per cent. of fibre. Until our chemists shall agree upon a common plan for fibre determination, we shall always be very much at sea in regard to this important factor in our sugar manufacturing calculations.

The recent unsatisfactory experiences of the Kenilworth Company in the manufacture of paper from bagasse have come about largely from the fact that sugar cane bagasse is somewhat refractory, perhaps more so than ordinary wood pulp, and requires expensive treatment, and, in the end, gives a considerably less yield of paper than estimated and expected. It would seem that in the manipulation of bagasse with boiling water and the proper alkalis, a considerable amount of so-called fibre in the ordinary layman's acceptation of that term is dissolved.

It is not alone in Louisiana that these unsatisfactory experiences in handling fibres have arisen. In Europe it has been found quite difficult to secure the accepted results from any given quantity of cellulose, and it has been found that all plants and woods contain within their interstices certain gums or viscous matter which not only fill the interstices, but also enclose small cells. There are also certain resins and coloring matter in some of the woods used in paper making, and the processes of manufacture when the wood is ground to a pulp result in the disappearance of these gums, resins, etc., in the solution and a resulting diminished yield of solid matter.

Efforts are now making to secure from the water, as by-products, such of these solids in solution as may have commercial value. If any success be had in this direction, it may be that we shall yet find that bagasse will come to the front as a first-class paper stock, but at present, at least, it is under a cloud for the reasons hereinabove given.

This whole matter is of especial interest to sugar planters because of the present practical impossibility of determining our comparative mill extraction. Some mill houses will claim to get 85 per cent. in juice of the weight of the cane ground, and we know that 70 per cent. is probably about the common average of good mill work, and 75 per cent. is very good, and not a great many of our sugar houses attain to that figure.

In determining the very large extraction at times claimed, certain allowances are made for the water used in the saturation of the bagasse. The bagasse, as a rule, is not weighed, and the measurements of the juice extracted may not always be accurate, and therefore a determination in this way always carries with it a considerable degree of uncertainty.

The common way of determining extraction is to take what is presumed to be a fair sample of the bagasse and to soak it in water and then evaporate it, or press it to dryness, until only the woody fibre remains, which, if then taken at an assumed 10 per cent. of the original cane from which it came, leads usually to the determination of the extraction. The 10 per cent. factor is, however, so uncertain as to diminish confidence in the accuracy of this method, and, again, if very hot water be used and considerable time taken in the experimenting, the bagasse will probably be so diminished in quantity as to represent no more than 8 per cent. of the weight of the cane from which it came. It would thus indicate a very large amount of juice left in the bagasse, and lower the percentage of mill extraction correspondingly.

The determination of extraction has given considerable trouble to the sugar chemists in the Hawaiian Islands, and they have been endeavoring, as has been shown in this journal, to formulate some common plan which, while perhaps only tentative, should be adopted by all of the chemists there, so that their results would at least be comparable, the one with the other, whether accurate or not. The very small yield of good paper stock from bagasse secured during the last two years at the Kenilworth paper mill gives more than usual force to the necessity for such uniformity of methods in fibre determination.—[Louisiana Planter.]

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SUGAR AS FOOD.

One of the most interesting bulletins issued for some time by the Agricultural Department is one on "Sugar as Food," prepared by Mrs. Mary H. Abel.

The author opens her treatise with statements of the consumption of sugar in various countries, England leading with 86 pounds per capita, and the United States next, with 64.

Next, the chemical composition of sugar is considered, and its elements of carbon, hydrogen and oxygen analyzed. Cane sugar dissolves in about one-half its weight of cold water, and melts at 520 Fahrenheit. Of the other kinds of sugars there is dextrose, or grape sugar, which is less sweet than cane sugar. Commercial glucose is dextrose, made by hydrolizing starch. Milk yields from 4 to 5 per cent. of sugar, which is not found in this form elsewhere. Honey contains glucose and levulose, known as "invert" sugar.

Cane sugar, or sucrose, is found in stems and roots of grasses, especially such plants as the sugar cane and sorghum; also in the beet, carrot, turnip and sweet potato; in the sap of trees, as the date palm and sugar maple, in sweet fruits and the nectar of flowers.

Sugar from the sugar cane was known in China 2,000 years before it was used in Europe. It was called by the Greeks "Indian salt." A German traveler in 1598, describing Queen Elizabeth, then 65 years old, said: "Her nose is a little hooked, her lips narrow, and her teeth black, a defect the English seem subject to from their great use of sugar."

A Berlin chemist discovered in 1747 that beets contained crystallizable sugar identical with that of sugar cane.

Many experiments have been made to ascertain the value of sugar as muscular food. Under certain conditions of the system sugar has no advantage over starch, except as a preventive of fatigue. In small quantities, and not too concentrated, sugar will take the place of starch as food for muscular strength. In times of great exertion the rapidity with which sugar is assimilated gives it an advantage over starch. Sugar has been used with beneficial effect in keeping up the endurance of athletes.

A fact stated in the treatise is the effect of the eating of sugar cane on the plantations, which has frequently been noticed in Louisiana. A writer on the West Indies says: "From the free use of the sugar cane juice the negroes of the West Indies and every animal about the plantation at the time of harvest show every indication of the wholesome and nutritious properties of the juice."

There is no proof that sugar is harmful to the teeth, or that it produces gout. Eaten in excess, it is injurious. Two hundred and fifty samples of cheap candy examined by the Agricultural Department showed them to be largely made up of glucose. As to the use of sugar in the dietaries of children, Mrs. Abel deprecates its extensive employment as likely to destroy the taste for other foods. It is urged that sugar should not be incorporated with the mush or oatmeal, etc., given to children.

In conclusion, Mrs. Abel writes:

"One may say in general that the wholesomeness of sweetened foods and their utilization by the system is largely a question of quantity and concentration. For instance, a simple pudding flavored with sugar rather than heavily sweetened is considered easy of digestion, but when more sugar is used, with the addition of eggs and fat, we have, as the result, highly concentrated forms of food which can be utilized by the system only in moderate quantities, and which are always forbidden to children and invalids.

"It is true that the harvester, lumberman, and others who do hard work in the open air, consume great amounts of food containing considerable quantities of sugar, such as pie and doughnuts, and apparently with impunity; but it is equally true that people living in indoor life find that undue amounts of pie, cake and pudding, with highly sweetened preserved fruit and sugar in large amounts in cooked cereals, bring indigestion sooner or later.

"From a gastronomic point of view, it would seem also that in the American cuisine sugar is used with too many kinds of food, with a consequent loss in variety and piquancy of flavor in the different dishes. The nutty flavor of grains and the natural taste of mild fruits is concealed by the addition of large quantities of sugar.

"In the diet of the under nourished larger amounts of sugar would doubtless help to full nutrition. This point is often urged by European hygienists. In the food of the well to do, it is often the case, however, that starch is not diminished in proportion as sugar is added. That sugar, on account of its agreeable flavor, is a temptation to take more carbohydrate food than the system needs cannot be denied. The vigor of digestion in each particular case would seem to suggest the limit. A lump of sugar represents about as much nutriment as an ounce of potato, but while the potato will be eaten only because hunger prompts, the sugar, because of its taste, may be taken when the appetite has been fully satisfied.

"Sugar is a useful and valuable food. It must, however, be remembered that it is a concentrated food, and therefore should be eaten in moderate quantities. Further, like other concentrated foods, sugar seems best fitted for assimilation by the body when supplied with other materials which dilute it or give it the necessary bulk.

"Persons of active habit and good digestion will add sugar to their food almost at pleasure without inconvenience, while those of sedentary life, of delicate digestion, or of a tendency to corpulency, would do better to use sugar very moderately. It is generally assumed that four or five ounces of sugar per day is as much as it is well for the average adult to eat under ordinary conditions."—R. B. M., Picayune.

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SUGAR CANE AS GROWN BY THE BENGAL RYOT.

There are at least half-a-dozen kinds of sugar cane, *Saccharum officiararum*, grown in Bengal. The best-known varieties generally cultivated are what are known locally as the red or *kajoili* and the white or *dholi*. Besides the above two kinds, there is a variety known as *Bombay*, a stout cane of a light pinkish color, and which is said to give the best returns, but the cultivation of it is difficult, and is said also to take longer to come to maturity. Jackals and pigs are also very partial to it, so plantations of it are not common. There is also a kind of cane, grown mostly in the Eastern Districts, known as *kooshea*; it is of hardy nature and of trailing habit. This variety of cane, if once cultivated, will go on yielding crops for three or four years; the only thing necessary is to plough up the land after the canes have been cut, and to manure with *poudrette*, the name usually given to sweepings of all kinds, or ashes of cowdung cakes. The cane known under the name of *China*, and which was originally imported from that country, is only to be found now in some of the Southwestern Districts. The natives are very partial to this cane, as it is much hardier than other kinds, and stands drought better, and, owing to its hardness, neither white ants nor jackals, the two great enemies of our sugar cane plantations in Bengal, will touch it. The juice of the *China* cane is also said to be very rich in saccharine matter.

Sugar cane in Bengal is grown in all kinds and descriptions of soil; light, alluvial or loam are said to give better crops, but strong or clayey soil is said to produce juice that gives better return. Land required for sugar cane plantations is usually taken in hand fully six to eight months beforehand, and it is thoroughly ploughed and manured.

Manures containing a considerable proportion of phosphoric acid, and which are easily procurable in Bengal, are the best suited for sugar cane. I have found the following to answer very well: Oil cakes, stable litter, old and well-decayed cowdung, ashes of dung cakes, sweepings from fowl and pigeon houses, and guano, if available. In China, where the canes give the best results, a large proportion of human manure is used, but this, I fear, could never be introduced in Bengal, as the native prejudices are too strong against making use of any such manure.

The time for planting cane in Bengal varies a good deal; for, while in the Western Districts February to March are the months generally chosen, April to May are preferred in most of the central and Eastern Districts. The cuttings required for planting are usually cut from the top of the canes and in lengths of five to six inches. In order to enable the shoots to strike out more readily, the cuttings are first planted in a slanting position, in some wet or damp soil, preference being generally given to the edge of the water along some tanks or streams. If the weather be dry, the cuttings are watered about sunset, and they are left until the young shoots rise eighteen inches or so. They are then taken up and carefully planted in rows, a cubit apart each way. When putting down the cuttings, a handful or two of manure is put around the roots, and the whole, except the shoots, covered up with earth. When the canes are a couple of feet or so high, the ground between the rows is dug up, and no further care or trouble is necessary except irrigating once or twice when the canes are coming to maturity.

In parts of the country where white ants are bad, it is almost impossible to grow sugar cane; jackals and pigs do also a good deal of damage, and if the crops are heavy it is difficult to drive them out of the place.

Though the bulk of the canes are manufactured into treacle and sugar, a certain amount of them are cut into joints and eaten by the natives, and, when in season, sugar canes may be seen for sale in nearly every market. The canes begin to ripen about the beginning of the cold weather, but it is only a couple of months or so later, i. e., in December and January, that the crops are cut. The sugar canes are then cut and removed from the ground for expression of juice, and this is generally done in a corner of the field itself. The juice when extracted is strained or not, as the case may be, a small quantity of lime water is added in some parts, and it is then poured into large iron pans, placed on a platform made of clay, with fire places below. It is then boiled for a length of time, and when removed from the fire is allowed to cool; it is then strained and boiled a second time, till it acquires the necessary constituency.

The growers never manufacture sugar out of their treacle or *goor*, but sell it to others, keeping a small quantity for their family use. The better sort of treacle or *goor* is used a good deal in making sweetmeats, or to be eaten as it is, while the inferior sort, which looks black, and not very unlike coal tar in color and consistency, is used mainly in the manufacture of native tobacco.

There is nothing that fluctuates like the price of treacle in Bengal. I have known it to be sold at from Rs. 2 to Rs. 10 per maund, but Rs. 5 per maund may be taken as a very fair average.

The return or output of treacle per *bigah* varies nearly as much as its price, namely, from 10 to 30 maunds, but 15 maunds may be considered about the usual average.

The expenditure, including rent, cost of manufacturing the treacle, etc., never exceeds Rs. 30 per *bigah* of land, so the net profits come to nearly Rs. 30 per *bigah*, or Rs. 150 per acre.

From the above it will be seen that it is not too much to say that those who have created those now declining industries, tea and indigo, may also find a way to share in the handsome profits of cane-growing in Bengal.—Indian Planters' Gazette.

REPORT OF THE COMMISSIONER OF LABOR ON HAWAII.

(Continued from August Number, p. 343.)

Some 15 or 16 small plantations, most of them producing less than 2,000 tons each, employ only day labor, though they occasionally let out small contracts for special work when conditions are favorable. Usually the complaint of short labor upon a plantation was inversely as the proportion of contract cultivators among the employees, and probably laborers could be found with ease in the islands to-day to cultivate all the cane fields under the "profit-sharing" system. It is partly to the increase of this system that the sudden lessening of strikes and similar disturbances that followed the abolition of penal contracts is due. Upon 19 typical plantations, including some upon all four of the islands, there was a decrease from 10,871 to 6,015 in the total number of day men employed, from 1900 to 1902. Meantime the total crop of the same plantations increased from 127,000 to 135,000 tons, in spite of the drought in the island of Hawaii, which reduced the crop on the plantations reported on that island more than 10,000 tons, without lessening their area of cultivation. Had the average annual increase in the number of laborers employed on these plantations during previous years continued after 1900, they would have had nearly 12,000 instead of 6,000 day men on their pay rolls. This deficit represents approximately the increase in the number of contract cultivators on the 19 plantations in question within two years. The principal motive in extending these contracts has been to secure regular labor and prevent strikes. Men who have a stake in a plantation and are directly interested in the prompt performance of its work in all departments not only refuse to take part in labor agitation themselves, but promptly cooperate with the managers to keep things running in case of defection of day employees. Their attitude at the time of annexation is thus described by the manager of Ewa plantation in his report for the year 1900:

"The system of employing labor in companies for the cultivation of fields, from date of planting until milling, continues in a flourishing condition. There are engaged on this basis 755 men, subject to general supervision, the work of cultivating and irrigating almost the entire area of growing and ripe canes is in their hands. While the laborers came and went during the period of unrest following the termination of the (penal) contract system on June 14 last, there was practically no change of personnel in these "profit-sharing" companies; and whatever delay there may have been in other plantation work, this branch was not set back in the slightest degree."

A threatened strike on one of the largest plantations was recently averted by the readiness with which the contract men came forward to replace the laborers who refused to work. A delay in grinding at that time, for instance, would have meant a direct loss to every cultivator having ripe or rapidly maturing cane standing in the fields.

Some plantations reserve certain fields to be cultivated by day labor with a view to employing the women not working with the contract companies, or in order to keep a force of day men adequate for emergencies, or to carry their mill laborers over the dead season, or for the purpose of raising seed cane. Only in exceptional cases can all the cane on a plantation be raised under contract. The method has its disadvantages as well as its advantages, from the planter's point of view. There is a difference of opinion as to the relative cost of cultivating by day labor or by contract. The cultivators earn more money than the day laborers, but they require less supervision, voluntarily work longer hours, and do more work in the time they are actually in the field. An estimate, based upon statistics, of the number of day laborers and of contract laborers, respectively, required to cultivate certain areas would be inaccurate, because local conditions are so unequal, not only upon different plantations, but upon different fields of the same plantation, that they constitute a variable factor important enough to render results reduced to figures unreliable. It is the general opinion that the extension of the contract-cultivating system reduces the number of laborers required to run a plantation, and certainly it increases the economic incentive to industry on the part of each worker. But influences sometimes appear that counteract this effect to some extent. There is a less flexible distribution of labor under the contract system of cultivation that sometimes causes waste; that is, there are times when, if the locality in which each field hand was to work was at the absolute discretion of the manager instead of being fixed by a written instrument, the latter could employ the labor in his employ more productively. Contracting companies are less apt to adopt progressive methods of culture than are the managers; they stick to the hoe where the manager would introduce machines and animals.

A third effect of the system has been noted by a very intelligent planter, that relates not so much to the number of men employed as to the total product of the plantation. Under some conditions contract cultivation tends to limit production. The Japanese can figure out pretty accurately from the appearance of the cane the point at which they will get the maximum compensation for their labor. This is not always the highest possible return of cane from the land under their control. In other words, they have learned empirically the law of diminishing returns as applied to cultivation. But such factors as rent, expense of fertilizing and irrigating, and greatest economy of manufacture do not enter at all into their computations. Therefore, the amount of cane per acre which best suits their interests is not always the amount which best suits the interests of the plantation. Their maximum return and the planter's maximum return are not identical when figured into profits.

The average earnings of contract cultivators throughout the islands are over a dollar a day for each day of actual labor. They appear almost exactly a dollar in the statistical tables, but there were a few instances where the profits of companies whose contracts were closed were of necessity figured upon a basis of 26 days worked each month, because other data were lacking, when the probability is that each member worked less than that time. In exceptional instances members earned as high as $44 a month in single companies, and on certain large plantations, whose combined contractors numbered over a thousand, the average earnings for all companies were about $34 a month. On the other hand, there were a few instances where drought or other unfavorable conditions had prevented companies from earning fair wages. A few companies had failed; that is, the value of their cane was less than the total cash advances made them. On one plantation 11 out of 38 companies failed last year, but this was on account of certain unfavorable and largely experimental conditions under which they worked. Managers not unusually give a bonus to companies that do not make expenses, the amount thus given being sufficient to bring their average earnings up to those of day laborers. One planter guarantees a bonus sufficient to bring the earnings of the men up to $20 a month, which is more than ordinary fields hands receive, but is paid in consideration of the fact that the cultivators ordinarily put in considerable overtime in their fields.

Most of the cultivating companies are Japanese, as laborers of this nationality are most numerous upon the plantations, but, in proportion to their numbers, more Chinese than Japanese work under this system. In fact a majority of the Chinese doing field work are contractors. The Portuguese do not agree well enough among themselves to conduct such companies with uniform success, and with the Porto Ricans this form of cultivation is still an experiment. The Chinese possess a business integrity so habitual as to be almost automatic, which makes them desirable cultivators. No matter how bad the prospects of a company are, it is exceedingly rare for laborers of that nationality to desert a contract. But the Japanese have less sense of obligation in such matters. They have been known to abandon their fields and the plantation without compunction if the crop threatened to turn out poorly.

The sociological effects of the contract system are beneficial. There is a tendency, already noted, for the cultivators to scatter about in isolated cottages, which is advantageous upon the whole from both moral and physical considerations. They also learn something of business ways and responsibilities, of the use of money, and of self-discipline that they would not learn as hired hands. Probably they also make more rapid progress under this system toward higher social ideals and standards of living.

The details of the contracts have been worked out experimentally. Some plantations have lost heavily by making them too favorable for their employees, while others have got the advantage of their men to an extent that made it difficult to renew these agreements subsequently. A majority of the managers are of the opinion that the system is more expensive than day labor would be with an ample supply of men. They let their cane out on contract because they thus insure a certain, if not a cheap, supply of labor upon the plantation. They can count with reasonable certainty, if their contracts are fair, upon having at least an ample force of cultivators in their fields—and this security is worth money under present conditions. Because the contracts simplify administration, there are some managers who prefer them to any form of day employment, even to a penal contract, as a means of securing effective work. Judging from the testimony of planters at the present time and that printed in earlier reports published by the local government, the longer the system is practiced and the better it is understood, the more favorably disposed are the managers toward it. Tact and judicious business foresight play an important part in the success or failure of a manager handling these agreements, but under the conditions now prevailing they present the nearest approximation to a solution of the problem of a constant field labor supply that has yet been discovered.

Another form of contract, that prevails especially in the island of Hawaii, is the agreement between a plantation and a single individual by which the latter engages to plant cane either upon his own land or upon land rented from the plantation and to sell the same to the plantation for a stipulated price per ton. This is to be distinguished from the cultivation contract chiefly by the fact that the party contracting with the plantation is usually a single individual, that he generally assumes full responsibility for preparing land and planting as well as for bringing the cane to maturity, and that there are no co-operative features by which the planter supplies labor to the plantation or is directly supervised in his work by the agents of the latter. Of course there are modifications of these contracts in some instances by which they come to resemble cultivation contracts in certain features, but the classification is kept distinct in plantation administration. These agreements have arisen in response to definite local conditions, and the specific term "planter's contract" has been applied to them

The parties contracting to raise the cane in these agreements are known as planters while the second parties to the cultivation contracts are known as contract cultivators, cooperative cultivators, or profit sharers, according to variations in local parlance. In the autumn of 1902 the Planters' Association reported 8,851 contract cultivators and 1,662 planters in all the islands. Many of the latter, who cultivate small tracts of plantation land with their own labor, are classed with contract cultivators in the statistical tables. The distribution of these planters was as follows: On Kauai, 3; on Oahu, 17; on Maui, 40, and on Hawaii, 1,602.

The contract planter is the nearest approach to the small farmer that exists at present in the sugar business. The centralization of the industry has been in response to well-defined economic necessities, and has proceeded more rapidly in the Hawaiian Islands than in other sugar-producing countries because the requirements of irrigation made it necessary to establish large plants and to purchase large tracts of land at the outset when organizing many plantations, and the example of these reacted quickly upon the smaller plantations of the districts having natural rainfall. The advantage of wholesale production were so patent as soon as this method was in actual operation, that there was a rapid coalescing of the smaller establishments in this country where, on account of climatic conditions, cane culture had had its modest beginnings. But the balance of advantage has never remained so strongly in favor of extensive centralization in the region of natural rainfall as in other portions of the islands, and therefore the tendency to compromise the two systems has manifested itself there in the form of these planters' agreements.

The topography of the country and the system of land tenure have also contributed to maintain the small cultivators. Much of the land on the slopes of Mauna Kea and Mauna Loa, the two great peaks of Hawaii, along whose bases lie the Hamakua, Hilo, and Kau districts, is broken by ravines and steep hillsides. The steam plow is useless and even animal cultivation is difficult upon some of these tracts. They are sufficiently isolated from each other to make even the loose supervision given to contract cultivation companies, whose time at least is taken every day, difficult and expensive. As there is water and elevation enough to permit of fluming cane to the mills, railways are less common, and as the acre tonnage is light and the land is broken up by tracts unavailable for cultivation, the total area of a plantation compared with its tonnage and administrative and labor force is larger than in the irrigated districts.

The semi-arid lands that now form some of the most fertile irrigated plantations were formerly great tracts of scanty pasture, and were leased or sold to private parties in immense ranges, so that extensive unbroken areas easily came into the hands of plantation companies. In the country of natural rainfall, on the other hand, lands were always of sufficient value to insure their being broken up into smaller tracts. Considerable uncleared land remaining in the hands of the Government was taken up by homesteaders in allotments of a few acres, and there were small native proprietors and white farmers in possession before the sugar industry became extensive. These homesteaders and small farmers find it profitable at times to raise cane for the mills upon their own holdings, selling at a price per ton that has been agreed upon at the time of planting. Occasionally they can employ their time and such labor as they hire to better advantage by taking in addition to their own tracts a small portion of plantation land, receiving a lower price for the cane raised upon such land or allowing a share of the crop to the plantation in lieu of rent. Others engage to cultivate a portion of the plantation where hired labor cannot be profitably employed upon a similar basis. Each planter, in this sense of the term, is practically his own master, a small share or tenant farmer, or petty landholder. The planter's contract, therefore, has not arisen in order to correct a labor stringency or to insure the plantation against uncertainties of labor supply, but as a strictly agricultural institution in response to conditions that were climatic and topographical rather than sociological or economic.

These contracts may be made by three parties, the plantation, the land owner, and the planter who is to raise the cane—in case a third person owns the land in question—but more usually only two parties appear in the instrument. In some contracts, the planter clears the land, raises first-plant cane to maturity and also first rattoons, or a series of rattoons, so that the term of the agreement is three years or longer. The plantation customarily furnishes advances, which are usually timed by the progress of the crop rather than by the month. Seed cane and fertilizer may be supplied free or at a price fixed in the contract. Occasionally every detail of the cultivation—the number and date of hoeings, strippings, and other operations—is specified in the contract; but more usually the agreement is confined to the two cardinal points—the amount of advances and price of cane on one hand, and the promise to raise cane upon the whole tract of land specified upon the other. The plantation agrees to place flumes, portable tracks, or other conveniences for transportation at certain intervals throughout the fields at cutting time. The planter has the right to inspect the weighing at the mill. Payment is always by the ton, and is generally based upon a sliding scale proportioned to the net price of sugar in the San Francisco market at the time the crop is sold. Interest may or may not be charged upon advances. In some cases the plantation reserves the right to supervise the work and to place labor in the fields to complete operations promptly, at the planter's expense, if this appears necessary to the manager. Some plantations contract with their own employes as planters, stipulating to allow them a certain number of days a week, without pay, to attend to their fields.

A few of the planters are white men, a number are native Hawaiians and Portuguese, and a majority are Asiatics. Most of those planting upon their own land belong to the first three classes. The Asiatics are frequently storekeepers or small contractors in the vicinity of the plantation, or employees holding positions of some responsibility. A Japanese carpenter working at a salary of $52 a month was pointed out by the manager of one plantation as a man worth about $20,000, made in planting contracts. A Chinese storekeeper in the same locality has accumulated a considerable fortune—probably more than his Japanese neighbor—in the same manner. A white merchant in the vicinity of one of the Hamakua plantations keeps about 10 acres in cane. He employs Japanese labor, and reports that at $4 a ton for cane, it is necessary to raise a crop of 30 tons to the acre to make expenses. The price paid per ton by the mills averages about $4 in Hawaii. This is the usual price paid on sliding-scale contracts when sugar nets 3 1-2 cents a pound at San Francisco. A typical sliding scale has been given in the specimen planter's contract. The plantation always pays taxes upon its own land. The arrangement as to rent varies. In one case 3 or 4 tons of cane an acre is charged; in another one-seventh of the crop is taken; and in yet another 25 cents a ton is deducted from the price of the cane for rent. This makes the price paid for the use of the land range from $7 to $12 an acre. The planter's contracts have enabled some plantations to extend their area of cultivation greatly, especially in the mountains. One plantation has raised its annual crop from an average of about 4,000 tons to 12,000 tons in the last 10 years, largely by extending its field area in the broken uplands through this form of agreement with small cultivators.

Job work is done on many plantations under some form of verbal agreement constituting a contract. Ground is cleared by the acre, ditches and tunnels are dug by the linear foot, portable tracks and flumes are laid, and cane is cut and loaded in this way. The Japanese especially prefer to undertake work under an understanding of this sort. Cane harvesting is done by contract, partly because it is an employment that does not last throughout the year and where the unit of work is easily measured, and partly because such contracts give greater assurance of a steady supply of cane at the mill. It is for the same reasons that these two operations of cutting and loading are usually omitted from cultivating contracts. They require a large temporary force, working actively over a comparatively limited area. The usual price for cutting is from 20 to 25 cents a ton, or 3 or 4 cents a line of 30 feet of cane for cutting, and from 15 to 22 cents a ton for loading. Cutters average 4 tons and loaders from 4 to 6 tons a day, and where contracting gangs are of the same nationality for both kinds of work, they trade off occupations, resting by varying their employment occasionally. Where cane is delivered by cable, it has to be bundled in addition to cutting. One plantation pays 60 cents a ton for cutting, bundling and delivering at cable—22 1-2 cents for cutting, and 30 cents for delivering at cable, but not for cutting or bundling. This would make bundling cost about 7 1-2 cents a ton.

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FORESTRY IN ITALY.

In a recent report Mr. Neville-Rolfe, British consul in Naples, refers to the widespread interest now being taken in Italy in the question of reforestation. In 1877 about 4,000,000 acres were withdrawn from the operation of the old forest laws, as well as about 1,000,000 acres in Sicily and Sardinia. The consequence was a reckless destruction of forests; and now it is generally admitted that the state must step in to save those that are left and to aid in replanting. The question now being discussed is what trees are to be used for the latter purpose. The Italian oak is of little use except for railway sleepers; there is plenty of chestnut all over the country, and pine trees would grow luxuriantly and prove most useful. The cork tree, however, appears to be the one which would prove economically the most valuable, and it has hitherto been almost wholly neglected in Italy. In 1900 the cork exported was valued at only $180,000, and much, no doubt, was used at home. But a few years ago Spain exported wine corks to the value of over $5,000,000.

In Italy about 197,000 acres of land are under the cork tree, chiefly in Sicily and Sardinia; in Portugal the area is 741,000 acres, in Spain 617,000 and in Algeria 694,000 acres. The Calabrian cork forests have been almost wholly destroyed, the trees having been burnt for charcoal, and even Sicily now imports corkwood in considerable quantities. Seventy years ago nearly all the cork imported into England came from Italy. But since then most of the Italian forests have been destroyed for charcoal and to produce potash, and those that remain are being devastated for the same purpose; and no one thinks of replanting the ground, which naturally gets washed away, owing to the absence of trees. Large forests containing a majority of cork trees are continually being released from the forest laws, and there is a risk that the production of cork in Italy will soon cease. Nothing can replace cork in its manifold use, and now, when vast quantities are used in making linoleum and in shipbuilding, an adequate supply of it is of great economic importance.—Forestry and Irrigation.

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STUDYING FOREST FIRE PROBLEM.

Last year within two weeks over $12,000,0000 worth of timber and other property was destroyed by forest fires in Oregon and Washington. This enormous loss occurred upon a restricted area and represents only a very small part of the annual loss from this source. Every timbered region of the United States suffers year after year from fire. The annual loss is estimated at from $25,000,000 to $50,000,000. Forest fires have been regarded as almost inevitable, and few systematic attempts have been made to prevent or control them except in the states of New York, Pennsylvania, and Minnesota, which have efficient systems of fire protection.

The Bureau of Forestry has this year undertaken a thorough study of the forest-fire problem in several different regions. It has placed men in forest districts to study fires while in the process of burning. Instead of waiting until the fires are over and relying for information on local reports, as has been done heretofore, the fires are now being observed by the Bureau's agents, and full data will be obtained as to how they were caused, how fast they burn, what conditions favor or hinder them, and just what damage they do to the soil and to tree growth. Each agent of the Bureau has been assigned to a district and is investigating all fires that occur within his territory. For example, one man studies a lumber tract, another a farming district, a third a turpentine orchard.

In connection with this detailed study, the agents will observe the methods of fire protection practiced by railroads and other owners of timber lands. The fire warden systems of the states which have forest fire laws and the patrol system in use on the federal forest reserves will also be observed closely.

By such methods the Bureau of Forestry hopes to replace with carefully gathered facts the vague general notions that now exist about forest fires. When the problem is solved for any particular region, the Bureau will be ready to recommend methods of fire prevention and control for the private land owner, and to suggest forest-fire legislation for the various states.

The investigation is now in progress in northern Florida and Southern Alabama and Georgia under the direction of Ernest A. Sterling. H. J. Tompkins, with a small corps of assistants, has begun work in Minnesota, Wisconsin and Michigan. Later in the season a study of forest fires will be made on the Pacific coast.

IRRIGATION IN INDIA.

In view of the great irrigation works being planned by the federal government, the report of irrigation works for India recently published by the British government is of interest. According to this report, the "productive works"—that is, those constructed out of loan funds in the expectation that they would prove directly remunerative—yielded a net revenue of about $8,000,000, the largest on record, equivalent to a percentage of 7.36 on a total capital outlay of $110,000,000. This percentage has only once been exceeded, viz., in 1897-'98, when it was 7.50. The most profitable results were obtained in the Punjab and Madras, where the percentages were 11.24 and 9.05 respectively. Out of 35 works classed as productive 13 (including all the canals in Bengal, the Deccan and Gujarat) are never expected to cover the interest on the capital outlay. The 22 actually productive works yielded 10.11 per cent. One canal the Cauvery delta in Madras, returned 34.81 per cent. If the total surplus profits be added together, the open canals have produced 27½ per cent., after paying all charges for interest and working expenses.

No new productive works were opened in 1900-1901, but about $3,000,000 was spent on seven new works in Upper Burma, the Punjab and Sind. With regard to works constructed out of the famine grant as "famine-protective works" not expected to be remunerative, it is noteworthy that they yielded a return of 2.35 per cent. on capital. But this is largely due to the great and increasing success of the Swat River Canal, which alone yielded 10.41 per cent. Five more protective works are under construction. There is a large number of "minor works," which irrigated 2,625,456 acres in 1900-1901, and returned 7½ per cent on capital. Those in Sind proved the most lucrative, yielding 26.18 per cent. Another class of "minor works," for which no capital accounts are kept because they were mostly constructed under native rule, irrigated 2,581,829 acres. Moreover, Madras Presidency has 28,000 tanks and 6,000 irrigation channels, irrigating 3,173,250 acres. The total area irrigated by all descriptions of works in 1900-1901 was 19,646,000 acres, the largest on record. The total capital outlay on works for which capital accounts are kept has been about $141,000,000, yielding in 1900-1901 about 6¾ per cent, after payment of interest, etc. The value of the crops raised on the irrigated area during the year was estimated at $138,000,000, or approximately the amount of the capital outlay.—Forestry and Irrigataion.

IRRIGATION OF SUMATRA TOBACCO.

Description of an Interesting Industry Now Flourishing in Florida.

By Clarence J. Blanchard.

Florida, in the minds of Northerners, has been associated so long with fruits and flowers that it comes rather in the nature of a surprise to find agriculture developed there on a scale commensurate with many sections of the North. Northern brains, money, and push are responsible in some degree for the revival, but Floridians are awakening rapidly to a better appreciation of the latent possibilities of their state, and while welcoming their brothers from the North are themselves adopting the latest ideas of farming with success. Scientific methods, improved machinery, and diversified crops, are gradually replacing the old customs, the antiquated machinery, and the one-crop system. The results are already reflected in better homes and a more industrious and cheerful people.

The city of Quincy, county seat of Gadsden county, is in northwestern Florida, in that narrow strip of land lying just south of Georgia. It is in the heart of the famous Sumatra tobacco district, the product of whose plantations scored 20 points higher at Paris than the leaf from the island of Sumatra. Recently I spent a day driving over the plantations of the Owl Commercial Company and Schroeder & Arquimbau, two of the largest planters in the state.

The Sumatra plant requires special soil, cultivation and irrigation to bring it to perfection, and the success of the planters in Gadsden county has not been achieved without the most careful study of the plant's needs, and long and patient experimenting with soils and fertilizers. The plant also requires protection from the direct rays of the sun; hence these large plantations are covered with framework over which are stretched millions of yards of cheese cloth, or over which miles of narrow slats have been placed. The soil is prepared with utmost care. Twenty-six wagon-loads of stable manure, and one and one-half tons of cotton-seed meal per acre are thoroughly mixed with the soil. The plants are grown from the seed, which is usually planted in a small clearing in a swamp, and under cheese cloth. As soon as they have reached the size of young cabbage plants they are transplanted.

The young plants are carried in baskets by women or children, who follow the men down the rows. With a sharp-pointed stick the planter makes a hole about 4 inches deep, into which he places the plant, backing the earth about it with a few deft touches. The plants are set about 14 inches apart, the rows being about two feet apart. When the field is equipped with an overhead pipe line with sprays every 33 feet, the plants are irrigated in the evening; otherwise the watering is done with a dipper in the morning. From ten to fourteen thousand plants are set to the acre. As soon as the plants are firmly set a "scooter" is run between the rows, throwing up a flat-bottomed furrow in which the water is run from wooden troughs which divide the field at regular intervals. These troughs are supplied from the reservoirs above the field, or from pipes directly connected with pumping plants on the streams. In the overhead system, now recognized as the most perfect and satisfactory method of artificial watering, two-inch pipes run over the frames in parallel lines about 40 feet apart, extending all over the fields. At intervals of 40 feet a small iron pipe extends upward and about 4 feet above the shades, the upper end being closed with a spraying attachment. When the water is turned on in the pipes it comes out of the sprayer in a fine mist and falls like a gentle rain upon the plants. Sumatra tobacco is cultivated constantly, no weeds or grass being permitted to grow in the field. A constant watch is kept to prevent injury from the pests to which the plant is subject. The first of these and probably the worst is the black cut-worm, which working under ground cuts the young plant down near the roots. Should the plant survive this enemy, the planter keeps a lookout for the bud-worm fly, an insect that lays its eggs in the center of the bud and bits a hole in the new leaf not larger than a pin point, but which will be as large as a silver dollar when the plant is full grown. Paris green and corn meal prove effective against this pest, and are applied like common insect powder. When the plant has grown to some height the green horned worm, with insatiable appetite, makes his appearance. He eats a leaf 12 by 24 inches in a single night and still is not satisfied. The grasshoppers, too, cause much annoyance, and the planters fight them in various ways. When they are very numerous they are rounded up by a large force of laborers and driven out of openings in the sides of the fields. When not too numerous, Guinea fowls are introduced into the fields, and they soon complete the destruction of the hoppers. A Guinea hen in full action after a grasshopper is a sight not soon forgotten, and the insect has but a small show for his life. Boys and girls with wooden flappers go over the fields at regular intervals and aid in the destruction of the hoppers.

Tobacco grows amazingly fast, in some instances attaining 9 feeet in 37 days, and the plants must be frequently supported by strings attached to the frames. When the tobacco is gathered it is taken to drying-houses, which are immense barn-like structures with large openings to permit the free passage of the air. When thoroughly dried it comes to the warehouse for sorting into its proper grade. There are 9 grades—light, medium, and dark, with spotted and plain of each of the above. Other grades are called seconds, strippers, fillers, and trash, the latter being the waste after sorting. All the work of sorting and grading is performed by colored women. Children are employed in stripping. For a period of not less than nine months the tobacco goes through a sweating process. Then it is weighed and bulked down. Later the bulks are changed, the center of the package being placed on the outside. Then it it is brought to the casing room and moistened. After this it comes to a sorting room, where it is graded by colors. Next it is sent to the tyer's table, where is it tied up after the leaves have been sorted and sized. The packages then go back to the bulk-room, where it goes through a process of drying out. It is then brought back to be sized to the inch, and is put into bales, which are again stored for two weeks or more. The bales are then burlappped, marked according to grade, and shipped.

A fair yield of Sumatra tobacco in Gadsden county is a thousand pounds to the acre, although it frequently runs as high as fourteen or fifteen hundred. The finest leaf brings as high as $6 a pound, although the average is probably not more than $3.50. This industry requires the investment of large capital, gives employment to a small army of colored people, and has become a strong factor in the material development of Gadsden country.—Forestry and Irrigation.

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COMPETITIVE CONDITION IN SUGAR PRODUCTION.

Representatives of the sugar trust confess that any attempt whatever to restrict the price of sugar has ceased to be practicable, and they thus admit that the trust has completed the circle and arrived at the point from which it started. The trust was organized to arrest, in a way which should be final, the conditions of competition which prevailed sixteen years ago, and after doing this with considerable success during most of that period, it has been brought face to face with conditions much less easy to handle than those which it originally encountered. Several attempts have been made in the course of the last year or two to evade the natural operation of the laws of commerce which have been steadily undermining the basis on which the trust was constructed, but the upshot of them all is to be found in a frank recognition of the fact that "sugar has passed beyond the point when it can be handled as a restricted article."

It was in 1885 that what may be called modern conditions appeared in the business of sugar refining. In New York and Philadelphia refineries were built on a scale of unprecedented cost and capacity, and utilizing new processes, mechanical and otherwise, the more progressive refiners were marketing increased quantities of their sugars at prices which were driving others from the field. The Havemeyers showed what could be accomplished under conditions of free competition by selling at a profit for export during the last year before the formation of this trust at least 100,000 tons of standard granulated sugars. At Philadelphia Claus Spreckels had selected the site for an enormous refining plant built expressly to compete with the Havemeyers, and, as John De Witt Warner put the case, it was evident that the American people were in actual danger of having cheap sugar; that the owners of antiquated refining plants might in a few years be compelled to charge them to profit and loss, and that, unless something was done, even the Havemeyers would soon be compelled to content themselves with such returns from capital as in fair competition with an equally enterprising refiner he and they might be able to fix.

It was to head off such a contingency that the original sugar trust was formed. With the less enterprising refiners who saw their old plants becoming worthless, there was little trouble in coming to an agreement. The basis of the combine was supplied by the issue to the owners of the old refineries of preferred certificates in the new association equal to the cost of their plants. The new refiners received in preferred certificates an amount many times that of their actual investment, since, unlike their less progressive associates, they had at least something to sell. An additional number of certificates, representing nothing but water, were issued to each associate equal to the amount of the preferred stock which had been allotted to him, and it only remained to come to some working agreement with the great distributing agents of sugar to relieve everybody of all concern about the destructive effects of competition on the profits either of the manufacturer or the wholesale grocer. Before the formation of the trust the latter had been selling sugar on the slenderest possible margin of profit, or on no margin at all. In the West and Southwest particularly, sugar prices were largely used for advertising purposes and profits sacrificed accordingly. Even in New York the great grocery houses had reduced the profit in sugar to the lowest point consistent with safety, while the refiners were competing with each other to supply them upon similar terms. When the trust was formed it practically controlled the supply for New England, New York and vicinity, and, from New Orleans, the lower Mississippi valley. It competed on even terms with the Philadelphia refiners for the Middle West and Northwest, while Spreckels was left undisturbed from the Missouri river to the Pacific coast—the trust controlling about 70 per cent. of the total markets of the United States. With the absorption of the Philadelphia refineries some years later, the command of the trade by the trust became, for some years at least, literally absolute.

The effect of prices of the new combination was very quickly demonstrated, though the fall in price of the raw material helped to disguise the fact from the consuming public. Before the formation of the trust the difference between the cost at which the refiner purchased his raw sugars and the price at which the retail dealer received from the jobber his standard refined granulated was frequently not more than three-quarters of a cent per pound. Analyzing the figures, seven years after the formation of the trust, Mr. Warner found that in spite of the extraordinary cheapening of the cost of raw sugars, which would make the old margin an exorbitant one in 1894, the difference, east of the Rocky Mountains, between the price paid by the refiner for 96 deg. centrifugals and that paid by the retailer to the jobber for standard granulated was 1 3-8 cents per pound, in addition to freights and charges. A much higher figure prevailed from the Rocky Mountains westward to the Pacific coast, and the enlarged margin was no longer offset by special discounts offered by competing jobbers. The jobbers and wholesalers had long since made an amicable arrangement with the trust under which they were guaranteed a commission or rebate of 1-4c a pound in return for a steadfast maintenance of price fixed by the trust. This bargain was changed from time to time, and the form of agreement under which the trust and the wholesale grocers co-operated to keep up the price of sugar underwent several modifications. But in essence it continued to be what it was in the beginning—a bargain for mutual protection between producer and distributor, and a method of taxing the consumer at a rate sufficiently high to insure quite a liberal margin of profit both to the refiner and the seller of sugar. How radically these pleasant relations have been disturbed may be inferred from the statement, reported in our news columns the other day, from a representative of the trust. Putting in brief form the results of years of experience, this gentleman said: We have found that when a big refiner establishes a profitable basis for the small refiners to sell on, it is simply holding the umbrella for its smaller and weaker competitors, and we have gone out of the umbrella business. When the grocers come to us to ask us to establish a basis on which they can make money, we say we believe they ought to make money, and we are willing to help them make money if they will help us. But they say that this is impossible, so that there is nothing for us as business men to do but to have an open market and sell our full proportion of the sugar consumed in this country by ordinary business methods." In other words, the trust system, as applied to the production and distribution of one of the necessaries of life, has been a demonstrated failure. It has required less than half a generation to demonstrate that fact, and, considering the strength and ability of the sugar combine and the magnitude of the interests involved in its preservation, it can hardly be said that the working of the natural laws of commerce has been either slow or uncertain.—N. Y. Journal of Commerce.

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A LONG WATER TRANSMISSION.

Australia claims a record piping of water, the distance being 350 miles. A large dam, the Mundaring weir, which is 90 feet high and impounds 5,000,000,000,000 gallons of water, has been constructed across the Helena river near Perth, and water is pumped from the reservoir formed through steel mains at the rate of 6,000,000 gallons per day. There are a number of auxiliary reservoirs and pumping stations along the line, which runs parallel with the railroad into the Kalgoorlie mining district, reputed to be the "richest square mile of earth on the globe." This district lies in the extremely arid interior of Australia, where there is no water to be had, and the wealth of the mines makes such a stupendous venture a paying one. The water is not used for irrigation, but for general purposes in the mining town. The engineering feat involved is noted because of its possible bearing on the question of long-distance transmisssion of water.

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Sugar making became an industry in America at a very early date. The historian, Lafittoll, writing in 1700 to 1705, tells how the Indians made incisions with their tomahawks or hatchets in the sides of the trees, from which the sap of the trees dripped, and then was afterwards boiled over a fire, making, we presume, the maple molasses of such world-wide repute. Lafittoll remarks that the French soon began to make this better than the Indian women, who previously had a monopoly of its manufacture. Bossu, writing in 1756, is equally explicit as to the source of our domestic sugar making.

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SUGAR INDUSTRY OF QUEENSLAND.

Report of the Registrar General for 1902.

In a recent number of the "Queensland Sugar Journal and Tropical Cultivator" appears the report of the Registrar General on the Sugar Industry of Queensland for 1902, which contains much interesting information. The report says:

In 1902 the total area under cane for sugar was 85,338 acres, of which the produce of 59,102 acres was crushed, yielding

641,927 tons of cane, from which 76,626 tons of sugar were obtained.

The extremely dry weather experienced during 1902 militated greatly against the success of the sugar crop, and drew attention yet more forcibly to the urgent need for irrigation. The necessity had been recognized by some even before the lesson taught by the past two seasons; and notably on the Burdekin delta, where cane has been irrigated for years past, and at Bingera, on the Burnett, schemes for the use of water artificially obtained and applied were adopted. In the former case the result was to place Ayr for the year 1902, as in 1901, at the head of the list with the most satisfactory proportionate results; whilst, unfortunately, at Bingera arrangements were not sufficiently advanced, neither was the supply of water enough to enable any very extended areas to receive the benefits of irrigation, but practically the only crop obtained was from the watered areas, and thus sufficient was accomplished to show what could be effected by irrigation and to afford every encouragement to the extension of the scheme.

The aggregate area, mainly cultivated for sugar, to which irrigation has been applied increased from 4,490 acres in 1901 to 7,541 acres in 1902—Ayr 3,896 acres to 4,070 acres; Bundaberg, 210 acres to 2,906 acres; Ingham (decrease), 80 acres to 70 acres; and Mackay, 304 acres to 496 acres.

The record year for sugar was 1898, when 163,734 tons were obtained, the average yield throughout the State from the 82,391 acres crushed being 1.99 tons to each acre. The acreage crushed in 1902 was 72 per cent. of the area for 1898, whilst of the tonnage of cane obtained the ratio was only 42 per cent.

Whilst the average yield of both cane and sugar to each acre crushed was very low owing to the dry season, yet, as just pointed out, from the same cause the juice of the cane attained a high degree of density, so that the average tonnage of cane required to produce 1 ton of sugar was considerably below the average.

The following statement compares the experience of each of the past five years on these points:

Year.	To Each Acre Crushed.		Tons Cane to One Ton Sugar
	Tons Cane.	Tons Sugar.	
1898	18.72	1.99	9.42
1899	14.81	1.55	9.54
1900	11.68	1.28	9.44
1901	15.10	1.55	9.76
1902	10.86	1.30	8.38

The average per acre of sugar made was slightly better last year than in 1900, but fell considerably short of the other three years, especially that of 1898; the average tonnage of cane was much less, indeed but little more than half that for the last-named year, and the reduced return as compared with 1900 was mainly caused by the much smaller area crushed.

This was not entirely due to the failure from weather, but partially to other causes. In ordinary seasons the area planted with sugar cane for use as foddder has no bearing on the question of sugar production, but it is always included in the agricultural statistics under the head of green forage. It is definitely planted for the use to which it is put, and has hitherto been of insignifiicant extent, amounting in 1901 to 595 acres only. During 1902 there were 15,067 acres thus put to profit, the great bulk of which was undoubtedly planted with the intention of converting the cane into sugar. The drought, however, caused such a demand for cattle feed of all kinds, and the prices ruling were so high, that growers found they could obtain a better return by the sale of cane for fodder. This area, therefore, though excluded from the sugar acreage of 1902, may be fairly included in considering the acreage available for returns for the coming season. Train loads of cane were frequently carried long distances. From Bundaberg and Wide Bay, where by far the largest areas were thus utilized, some of the produce came to the Brisbane district. If the additional area thus utilized during 1902, the produce of which in most cases was too small to crush, but was by no means a total loss to the farmer, had been converted into sugar, the output would have been considerably added to.

The question of the production of sugar in Australia as in other places where the sugar cane is cultivated, is intimately concerned with the changes now in progress with respect to the contributing of bounties by the continental countries of Europe.

Some progress in the direction required—the abolition of these bounties—has been made; and the confirmation by the various countries concerned of the recommendations arrived at by the conference held at Brussels in 1902 would afford much relief, although the attitude of Russia on the question leaves much to be desired. The Government of India had adopted the alternative of establishing a countervailing duty which Russia resents as a distinct breach of the "most favored nation" clause of the Treaty of Commerce, and at the same time asserts that her beet sugar industry is not supported by the bounty system, refusing to so recognize the scheme adopted for regulating the placing of sugar on their own markets, which consists in part of an excise duty, the same being refunded on all exported sugar. * * * * *

(To be continued.)